CHANNEL ALLOCATION METHOD AND DEVICE IN MOBILE SYSTEM AND A MOBILE SYSTEM BASE STATION

The present invention relates to channel allocation on a telecommunication connection between a base station and a base station controller of a mobile system. In particular, the invention relates to a mobile system such as GSM (Global System for Mobile communications), in which call-related telecommunication signals are conveyed through circuit-switched telecommunication channels between base stations and a base station controller. In this context a call refers to any traffic connection to be switched in a mobile system, such as a common voice call, or alternatively, a data call, for instance.

For instance, in the GSM system calls are switched over an Abis interface between the base stations and the base station controller on circuit-switched telecommunication channels, which in practice can consist of e.g. time slots of a 2 Mbit/s PCM (Pulse Code Modulation) connection. Then the PCM connection time slots, i.e. the telecommunication channels, are permanently allocated to transceiver units of the base stations. If any one of the transceiver units is not handling a call at a given moment, it means that the PCM time slot allocated to said transceiver unit is not in use.

The most considerable drawback of the above-described known solution is the great number of telecommunication channels needed for the telecommunication connections between the base stations and the base station controllers. Since the existing telecommunication channels are permanently allocated to a specific transceiver unit, the number of necessary telecommunication channels is dependent on the number of the transceiver units. Since the mobile systems are dimensioned, as far as possible, such that almost every base station has all the time idle transceiver units (which can handle new calls, when necessary), it means that a relatively great number of telecommunication channels between the base station controller and the base stations are constantly unused.

The object of the present invention is to solve the above-described problem and to provide a solution by which the degree of utilization of the telecommunication channels between the base stations and the base station controller of the mobile system can be increased to the effect that the existing telecommunication channels could be utilized more efficiently than before and the overdimensioning of the system could be avoided. This is achieved with a channel allocation method in a mobile system in accordance with the invention. The method of the invention is characterized by comprising the steps of

arranging in the system unallocated telecommunication channels between a base station controller and a base station, allocated in call set-up at least one of said telecommunication channels to the base station switching the call, and controlling the base station controller to transmit information to the base station on the telecommunication channel allocated thereto.

The invention further relates to a mobile system, to which the method of the invention can be applied and which includes a base station controller and at least a first base station and a second base station which comprise transceiver units for establishing a telecommunication connection by radio signals to the subscriber terminals located in the base station coverage area and switching means for switching the base station transceiver units onto a particular channel of a plurality of optional telecommunication channels between the base station controller and the base stations. The mobile system in accordance with the invention is characterized in that the base station controller comprises control means which in call set-up allocate at least one of said telecommunication channels to the first or the second base station for the duration of the call and which transmit a predetermined message assigning the allocated telecommunication channel to the base station to whom the channel is allocated, and that the switching means of the first and correspondingly of the second base station are responsive to said message for switching the base station transceiver units to the telecommunication channel assigned by said message.

The invention still further relates to a mobile system base station, which can be utilized in the system in accordance with the invention and which comprises transceiver units for establishing a telecommunication connection by radio signals to the subscriber terminals located in its coverage area, and switching means for switching its transceiver units to particular channels of a plurality of optional circuit-switched telecommunication channels. The mobile system in accordance with the invention is characterized in that the switching means are responsive to a message received by the base station in connection with call set-up for switching a particular transceiver unit onto a circuit-switched telecommunication channel assigned by the message for the duration of the call to be established.

The invention is based on the idea that telecommunication channels between the base station and the base station controller can be utilized more efficiently than before, i.e their degree of utilization improves, when the chan-

nel allocation is performed call-specifically. Thus a given telecommunication channel is only allocated for the duration of the call to a transceiver unit of the base station handling the call. When the call terminates, the telecommunication channel will be released, whereby it can be freely allocated to another transceiver unit. Said other transceiver unit can be a transceiver unit of the same or some other base station. The same telecommunication channel can thus be allocated call-specifically to various base stations. Hence a pool of free, i.e. unallocated, telecommunication channels is formed between the base stations and the base station controller, from which pool the base station controller allocates a free channel call-specifically to the base station that needs a channel for handling a call at a given moment.

The fact that a particular telecommunication channel can be allocated to a plurality of base stations enables reduction in the number of telecommunication channels. This is due to the fact that it is highly unlikely that all transceiver units of all base stations would simultaneously handle calls. Hence the number of telecommunication channels can be lower than the number of calls that the transceiver units are capable of handling simultaneously via a radio interface. Available telecommunication channels are thus allocated to the transceiver units of those base stations through which a call is going on.

Thus the most considerable advantages of the solution of the invention are that the degree of utilization of available telecommunication channels improves and the number of telecommunication channels between the base stations and the base station controller can be reduced.

In one preferred embodiment of the method of the invention, the telecommunication channels between the base stations and the base station controller are circuit-switched telecommunication channels that are classified on the basis of their characteristics into at least two categories, i.e. primary telecommunication channels and secondary telecommunication channels. In call set-up, a primary telecommunication channel, if available, is thus allocated to the base station, otherwise a free secondary telecommunication channel is allocated thereto. This embodiment in accordance with the invention makes it possible that secondary telecommunication channels can be arranged between the base stations and the base station controller to be used when all primary telecommunication channels are already allocated to a base station. Hence 'congestion' in the system, resulting from all channels between the base station and the base station controller being in use, can be avoided.

Classification of telecommunication channels enables the secondary telecommunication channels to have poorer characteristics than the primary ones. Alternatively, the use of secondary telecommunication channels may cause heavier costs than the primary channels to the operator, and therefore it is advisable to use them only exceptionally.

The preferred embodiments of the method, mobile system and base station in accordance with the invention are disclosed in the accompanying dependent claims 2 to 3, 5 to 8 and 10.

In the following the invention will be described in greater detail by way of example with reference to the attached drawings, wherein

Figure 1 is a flow chart of a first preferred embodiment of the method of the invention, and

Figure 2 is a block diagram of a first preferred embodiment of the mobile system of the invention.

Figure 1 is a flow chart of a first preferred embodiment of the method in accordance with the invention. The flow chart of Figure 1 can be utilized in telecommunication channel allocation between base stations and a base station controller in the GSM system, for instance.

In block A, circuit-switched primary and secondary unallocated telecommunication channels are arranged between the base stations and the base station controller, i.e. said telecommunication channels are not permanently allocated to any specific base station or transceiver unit in the base stations. The telecommunication channels are grouped on the basis of their characteristics such that the primary channels are of better quality, have larger data transmission capacity, are more reliable or inexpensive in use than the secondary telecommunication channels. Depending on the implementation, the telecommunication channels can also be grouped into more than two categories.

In block B, it is awaited until call set-up relating to a new call starts. In this context a call refers to any traffic connection to be switched in the system, for instance such as a common voice call, or alternatively, a data call.

In block C, it is checked whether any one of the primary telecommunication channels between the base stations and the base station controller is free. If it then occurs that one of the primary telecommunication channels is free, i.e. at said moment it is not allocated to any base station, said free chan-

nel will be allocated in block D to the base station that handles a new call to be established.

Instead, if it appears in block C that all primary telecommunication channels are already allocated at said moment, a transfer to block E is performed. In block E, it is checked whether any one of the secondary telecommunication channels between the base stations and the base station controller is free. If a free, unallocated, secondary channel is found, it will be allocated in block F to the base station that handles a new call to be established.

Instead, if it appears in block E that all secondary telecommunication channels, too, are allocated at said moment, the call set-up fails.

In block G, the base station controller transmits information on the allocated channel to the base station through the transceiver unit of which the call to be established will be handled. For instance in the GSM system, information on the allocated channel can be included in the CHANNEL ACTIVATION message in accordance with the GSM specification part 08.58, by which message the base station controller informs the transceiver unit on the radio channel to be used for the call.

In block H, it is awaited until the call has terminated, whereafter the telecommunication channel allocated to the base station for the duration of the call will be released in block I. Thereafter, if necessary, said channel can be allocated to a transceiver unit of another base station for the duration of a new call to be established.

Figure 2 shows a first preferred embodiment of the mobile system in accordance with the invention. The mobile system shown in Figure 2 can be the GSM system, for instance.

A base station controller BSC of Figure 2 communicates with a mobile services switching centre MSC and with base stations BTS1 to BTS2 in order to switch calls to mobile stations located in the coverage area of the base stations. The base station BTS1 comprises two transceiver units TRX1 to TRX2, whereas the base station BTS2 comprises three transceiver units TRX1 to TRX3. For each transceiver unit in the base stations BTS1 and BTS2, a dedicated signalling channel SIG1 to SIG5 is reserved between the base station controller and the transceiver units. Through said signalling channel a control unit 1 of the base station controller, for instance, conveys information to the transceiver units on the radio channel they should utilize at a given instant of time.

Unlike in Figure 2, it is not necessary to allocate a dedicated signalling channel to every transceiver unit, but signalling between the base station controller and the transceiver units can also be implemented with one single, shared (e.g. 64 kbit/s) signalling channel. The base station controller and the transceiver units can then add to the messages to be transmitted on the shared signalling channel, for instance, an identifier that indicates for whom the messages are intended. The transceiver units can also perform a so-called random access to the shared signalling channel by using their own identifier in connection with calls originating from mobile stations.

Circuit-switched data transmission channels CH1 to CH6 are also arranged between the base station controller BSC and the base stations, through which channels call-related telecommunication signals are conveyed between the base station controller and the base station transceiver units. The data transmission channels are grouped into primary and secondary data transmission channels on the basis of their characteristics. The primary data transmission channels CH1 to CH4 can be, for instance, time slots of a PCM connection transmitted via cable. The secondary data transmission channels CH5 to CH6 can be, for instance, connections between the base station controller BSC and the base stations conveyed via a satellite link. Hence the use of primary telecommunication channels is cheaper than the use of secondary telecommunication channels for the operator.

The telecommunication channels CH1 to CH6 are not permanently allocated to any base station or any base station transceiver unit. Hence for instance, the telecommunication channel CH1 can be allocated call-specifically to any one of the transceiver units in the base station BTS1 or BTS2. In the case of Figure 2, the telecommunication channel CH1 is allocated to the transceiver unit TRX1 of the base station BTS1. Correspondingly, the telecommunication channel CH3 in Figure 2 is allocated to the transceiver unit TRX3 of the base station BTS2. For instance, when the ongoing call through the transceiver unit TRX1 of the base station BTS1 terminates, the channel CH1 will be released, whereby the base station controller BSC can allocate it to some other base station or transceiver unit.

The allocation of the telecommunication channels CH1 to CH6 is performed by a control unit 1 of the base station controller BSC in connection with the call set-up. The control unit 1 allocates the telecommunication channel to that base station through which the call will be switched. The control unit

1 selects the channel to be allocated from a number of free primary telecommunication channels CH1 to CH4. Only, if there is no free primary telecommunication channel, it allocates a secondary telecommunication channel CH5 to CH6.

Having selected the telecommunication channel to be allocated, for instance channel CH4, the control unit 1 transmits information on the allocated channel to the transceiver unit of that base station through which the call to be established is intended to be switched, i.e. for instance, to the transceiver unit TRX2 of the base station BTS1. The control unit transmits this information on the signalling channel SIG2 of the transceiver unit TRX2, for instance in conjunction with the CHANNEL ACTIVATION message in accordance with GSM specifications part 08.58 (by which message a radio channel is assigned to the transceiver unit TRX2).

After receiving the message, which assigns the allocated telecommunication channel CH4, from the signalling channel SIG2, switching means S2 of the transceiver unit TRX2 of the base station BTS1 switch the transceiver unit TRX2 onto said channel. Figure 2 shows that the switching means of the transceiver unit TRX2 can switch it onto any one of the telecommunication channels CH1 to CH6. When the call is over, the switching means S2 in turn release the channel CH4 used for the call, whereafter the control unit 1 can allocate it to another base station or transceiver unit.

Unlike in Figure 2, the control unit 1 can allocate more than one telecommunication channels CH1 to CH6 to the transceiver unit of the base station for the duration of the call. In other words, if the capacity of the telecommunication channels CH1 to CH6 is 16 kbit/s, for instance, but the telecommunication resources allocated to the call (e.g. a data call) are on a radio path of 64 kbit/s, the control unit can simultaneously allocate four channels of 16 kbit/s CH1 to CH4 to the transceiver unit of the base station in order to provide the same data transmission capacity over the ABIS interface as on the radio path. A further advantage of not needing to overdimension the telecommunication channels CH1 to CH6 is achieved by this kind of dynamic allocation of telecommunication channels CH1 to CH6. In other words, since only some of the calls need extended data transmission capacity at the ABIS interface, it is unnecessary to design individual telecommunication channels to meet the highest imaginable need (e.g. 64 kbit/s), whereby only part of their capacity would be in use during normal calls. The capacity of the telecommu-

nication channels is utilized more efficiently by the above-described dynamic allocation, in which a required number of channels are allocated at any given time.

It is to be understood that the above description and the figures relating thereto are only intended to illustrate the present invention. It is obvious to the person skilled in the art that the invention can be varied and modified in a variety of ways without deviating from the scope and spirit of the invention disclosed in the accompanying claims.